Ground truthing orbital clay mineral observations with the APXS onboard Mars Exploration Rover Opportunity

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NASA's Mars Exploration Rover Opportunity has been exploring ~22 km diameter Endeavour crater since 2011. Its rim segments predate the Hesperian-age Burns formation and expose Noachian-age material, which is associated with orbital Fe^{3+}-Mg-rich clay mineral observations [1,2]. Moving to an orders of magnitude smaller instrumental field of view on the ground, the clay minerals were challenging to pinpoint on the basis of geochemical data because they appear to be the result of near-isochemical weathering of the local bedrock [3,4]. However, the APXS revealed a more complex mineral story as fracture fills and so-called red zones appear to contain more Al-rich clay minerals [5,6], which had not been observed from orbit. These observations are important to constrain clay mineral formation processes. More detail will be added as Opportunity is heading into her 10th extended mission, during which she will investigate Noachian bedrock that predates Endeavour crater, study sedimentary rocks inside Endeavour crater, and explore a fluid-carved gully. ESA's ExoMars rover will land on Noachian-age Oxia Planum where abundant Fe^{3+}-Mg-rich clay minerals have been observed from orbit, but the story will undoubtedly become more complex once seen from the ground.

References: [1] Wray J.J. et al. (2009) *Geophys. Res. Lett.* 36, L21201. [2] Noe Dobrea E.Z. et al. (2012) *Geophys. Res. Lett.* 39, L23201. [3] Arvidson R.E. et al. (2014) *Science* 343, 1248097. [4] Fox V.K. et al. (2016) *Geophys. Res. Lett.* 43, 4885–4892. [5] Clark B.C. et al. (2016) *Am. Mineral.* 101, 1515-1526. [6] Mittlefehldt D.W. et al. (2016) LPSC 47, 2086.